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Lighting of the Clothing Industry

Industrial illumination



Information compiled by
A. B. ODAY and R. W. PEDEN
Lighting Service Department

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Lighting of the Clothing Industry

Data compiled by A. B. Oday and R. W. Peden

Lighting Service Department

Introductory

There is no doubt but that the manufacture of clothing is one of our greatest industries. Under this heading may fall high grade articles made to special measure, ready-to-wear high grade goods, laborers' low priced coarse clothes, etc., and the establishment itself may vary from the modern tailoring establishment to the dark alley sweat shop. Thus we have an industry with greatly diversified working conditions and a large variety of kinds and classes of goods and materials, with a corresponding number of processes and exacting requirements.

As is true with nearly all large industries, the clothing industry has enjoyed rapid strides in the development of new and better machinery, as well as in the methods of operation; and today, even the most insignificant factory or shop is equipped with much up-to-date apparatus. This progress is all the more noteworthy when we stop to consider that it is only a comparatively short time since each family made most of its own clothing by hand from the raw material.

Present Practice

In an endeavor to determine the present practice of lighting in clothing factories, an investigation was conducted which included an inspection of approximately 100 factories. An endeavor was made to visit factories covering the manufacture of as large a variety of clothing as possible, also those in several different localities. Factories representing a large variety of product were encountered including underwear, coats, suits, hats, collars, corsets, brassieres, gloves, stockings, ties, waists, shirts, sweaters, furs and overalls.

The results analyzed as to lamps and power consumption, equipment and systems of illumination employed show that while nearly all were using MAZDA or Tungsten filament lamps, 86 per cent were using a type of lamp unsuitable for obtaining the most effective and economical results; 64 per cent were using sufficient power, which if properly applied would have produced adequate illumination; 22 per cent were using more power than would ordinarily be necessary to produce good illumination; 14 per cent would require a greater power consumption to produce adequate lighting; 10 per cent were using a variety of types and sizes of lamps for corresponding operations and showed that no effort whatever had been made in the way of standardization.

With regard to the type of equipment employed, 28 per cent were using antiquated tin shades; 20 per cent semi-obsolete steel reflectors; 16 per cent opalescent enclosing globes; 14 per cent were using modern equipment; 12 per cent used no reflecting equipment; 10 per cent were using inefficient and obsolete glass shades and reflectors.

Under the heading "systems of lighting," it will be noted that 86 per cent were found to be using the old drop cord system, whereas 14 per cent were using a fairly modern installation. It should be borne in mind, however, that this analysis embraced only the larger factories. As a matter of fact, an endeavor was made to locate factories which gave promise of a reasonably good lighting installation. If the small factories had been included, it is certain that a much smaller percentage of installations classed "good" would have been noted.

All of us interested in lighting will recall riding or walking through the garment manufacturing center of a large city, and noticing the lighting conditions under which the operators work. Many plants are still using the open flame gas jet. However, these are rapidly being supplanted by some form of electric lighting. It is quite common to see bare unshielded electric lamps in sizes ranging from 25 to 300 watts, suspended from drop cords, either close to the ceiling or near the eyes of the operator. This is particularly true of the smaller sweat shop variety of factory.

General Requirements

Modern lighting as applied to the clothing industry may be divided into three types, namely:

- (1) General illumination employing lighting units uniformly spaced and hung fairly high at a uniform distance above the floor.
- (2) Localized general illumination, employing a hanging height corresponding approximately to that used for general illumination, with the lighting units located with reference to the working position.
- (3) A combination of local and general illumination, employing individual lights located close to the working points, utilizing relative low wattage MAZDA lamps and small steel reflectors, this illumination being supplemented by a medium intensity of general illumination from overhead units.

Perhaps in no other industry is the distribution of light of greater importance than in the manufacture of clothing. In a large majority of operations encountered, shadows cast by machine parts or operators may be extremely objectionable and annoying. This is especially true where work is being done on fine material and visual perception has a definite bearing on the quality of work produced. In view of the exacting conditions encountered, particular care must be exercised in designing an installation, so that the distribution of light for a particular operation will adequately meet the requirements.

There is a tendency on the part of some of the factory owners to attempt to utilize a small number of relatively large lamps, rather than a greater number of smaller units on account of the lower wiring cost. The result usually encountered from such a

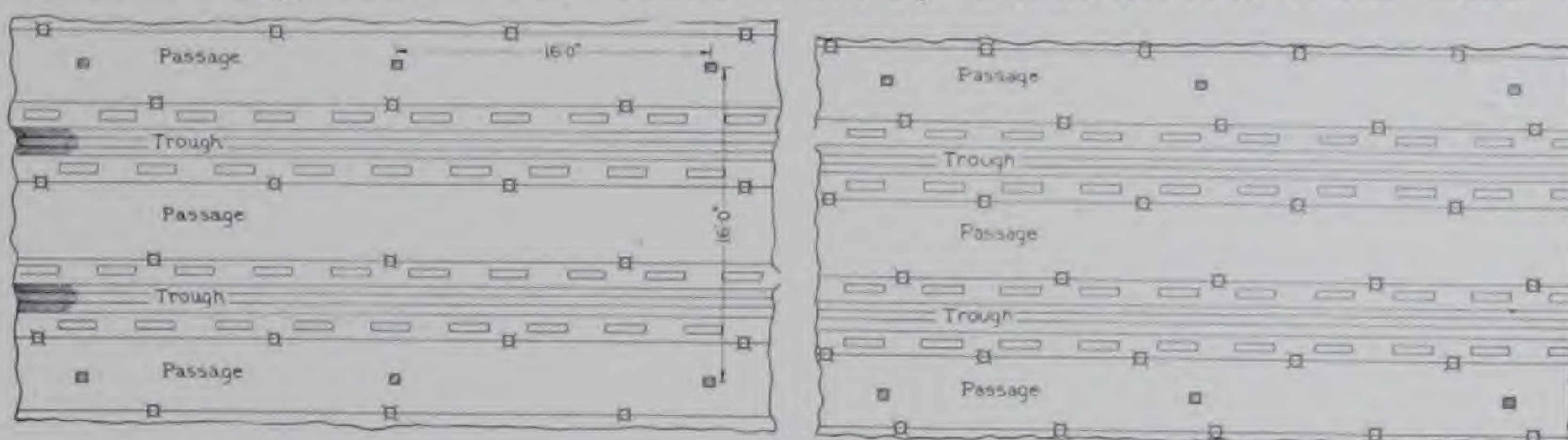


Fig. 1

Localized General Illumination for Machine Sewing. (a) Coarse Work, 100-watt Bowl Enamelled MAZDA C Lamps in RLM Standard Dome Reflectors Hung from 4 to 6 Feet Above the Table. (b) Medium Fine Work, 150-watt Bowl Enamelled MAZDA C Lamps in RLM Standard Dome Reflectors Hung 6 Feet Above the Table

procedure is uneven, "spotty" lighting. For specific information on this subject see Bulletin Index 13, "Calculation of the Lighting Installation."

The clothing industry, owing to the diversified requirements, calls for a wide range of intensity. For instance, in the shipping room, an intensity of 4 foot-candles will be found to give fairly good satisfaction, while in the sewing room an intensity of 20 to 50 foot-candles at the needle point may be required.

Wherever it is possible to do so in the clothing factories, it is recommended that the system of general illumination be employed. In other words, if the required intensity can be economically produced by the system of general illumination, such a system is recommended. If, on the other hand, the economic limit is passed before the intensity has reached the necessary point, a localized general system should be employed, with recourse to a combined local and general system, when the limit has been reached with the

localized system. Hence, it will be seen that with the diversified requirements, the theoretical proper intensity of illumination will vary for each factory and for each class of work being carried on, and consequently it will be difficult to set a definite limit. However, experimentation has proven that certain intensities which come well within the economic limits of good lighting, give beneficial results from every viewpoint, and therefore, recommendations are based upon these figures.

While forms of indirect lighting produce a very desirable character of illumination for many operations in the clothing factory, it is seldom employed, due to the higher operation expense. Direct lighting fixtures are more generally applicable. The types of direct lighting units which find application are the RLM Standard Dome, deep bowl steel, prismatic glass, opalescent glass, mirrored glass and various forms of glass and combination metal and glass enclosing and semi-enclosing units. All of these types, under proper conditions, will produce satisfactory results. (See Bulletin Index 22.) However, it is felt that from the standpoint of economy, distribution, maintenance and efficiency, etc., that the RLM Standard Dome reflector, especially when equipped with the bowl enameled MAZDA C lamp, will find most universal application.

The appearance of a factory, while not of paramount importance, is demanding more and more attention. Of the factors which add to or detract from the appearance of the interior of a clothing factory, one of the most important is the lighting installation. A multiplicity of fixtures and drop cords hung in a haphazard manner at non-uniform hanging heights, employing various types of reflectors and lamps, produce a general appearance which is far from pleasing to the eye. On the other hand, an installation which is uniform throughout adds to the attractiveness of the interior and creates a favorable impression on the minds of visitors or workers. Circumstances, however, do not warrant the introduction of highly decorated fixtures, as it is neatness and uniformity rather than decoration which counts. A system not well maintained does not only detract from the appearance but is a real liability. (See Bulletin Index 14.)

The processes in clothing manufacture are here briefly outlined with indications of the lighting requirements, both as to system and intensity. The more or less standard methods of producing the illumination for the different processes are given, following this analysis. (Tables I and II).

Requirements for Individual Operations

Machine Sewing

The requirements in a sewing room are very diversified. The type of machines, the quality of the work being done, the color of the goods, color of walls and ceilings, and the liability to accumulate dust must all be considered in deciding upon and laying out installations. It is, therefore, obvious when one considers the variation in these factors that no particular system can be selected for universal use in this particular department.



Fig. 2

Machine Sewing on Sweaters with Lighting as Suggested in Fig. 1. 100-watt bowl enameled MAZDA C lamps in RLM Standard Dome reflectors are hung 6 feet above the table in a staggered arrangement

The two main positions at which light is required on the sewing table are, first, at the side of the machine where the goods lie prior to being sewed together, and second, at the needle point. For the former a medium intensity of illumination will suffice. The requirements are that adequate illumination be provided so as to make it possible for the operator to distinguish between different pieces of goods and also between the different parts of the same piece. It is obvious, of course, that a greater amount of illumination will be necessary when work is on dark goods rather than light goods. Owing to the unsymmetrical arrangement of the goods

there is a considerable liability of shadows being produced, hence a well diffused, properly distributed illumination is essential if the vision of the operator is to be quick and sure. For this work a system of general illumination will be found applicable.

The light at the needle point, however, must be of a high intensity. A condition is seldom encountered where illumination below 8 foot-candles in intensity will prove satisfactory, and in many cases it is advisable to have this intensity as high as 50 foot-candles. As mentioned before, the color of the goods and the fineness of the operation are deciding factors with regard to the amount of illumination necessary. Where the conditions of work are of an ordinary nature, 8 to 12 foot-candles of illumination will

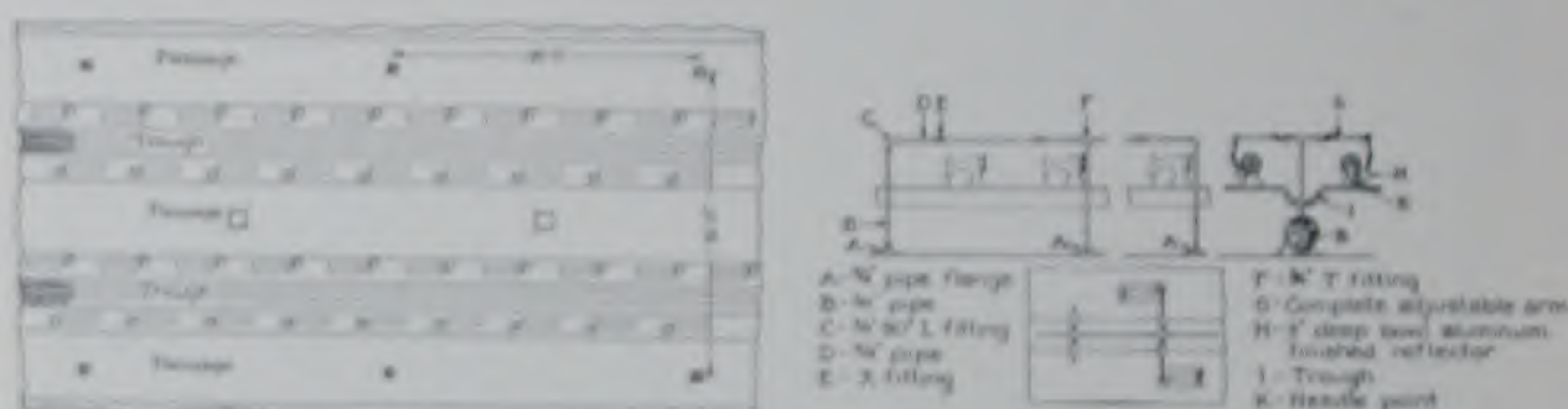


Fig. 3

- (a) Plan of Sewing Machine Tables with Lighting for Fine Work on Dark Goods. The local units are 15- or 25-watt, all frosted MAZDA B lamps in small deep bowl aluminum finished reflectors.
 (b) Satisfactory Method of Mounting Adjustable Arms for Local Illumination of Sewing Machines

produce fairly good results. Illumination of this character can be produced satisfactorily by an overhead system of general or localized general illumination. Layouts applicable for this type of lighting are shown in Fig. 1. With such a system the light comes from all directions and only very slight shadows are caused by the machines, operators, etc. The system as shown in Fig. 1a is suitable for work where only a comparatively low intensity is required, the effect by night of such an installation is shown in Fig. 2; whereas that shown in Fig. 1b is intended for work where a medium intensity is necessary. Where extremely high intensities are necessary, it is not considered economically advisable to use either of these two systems, inasmuch as the particular point where high illumination is desired is at the needle point, and if 40 foot-candles were supplied throughout the entire room, the system might not be particularly economical. Where such is found to be the case, it is advisable to furnish the high intensity of illumination at the needle point by a local lamp, while a some-

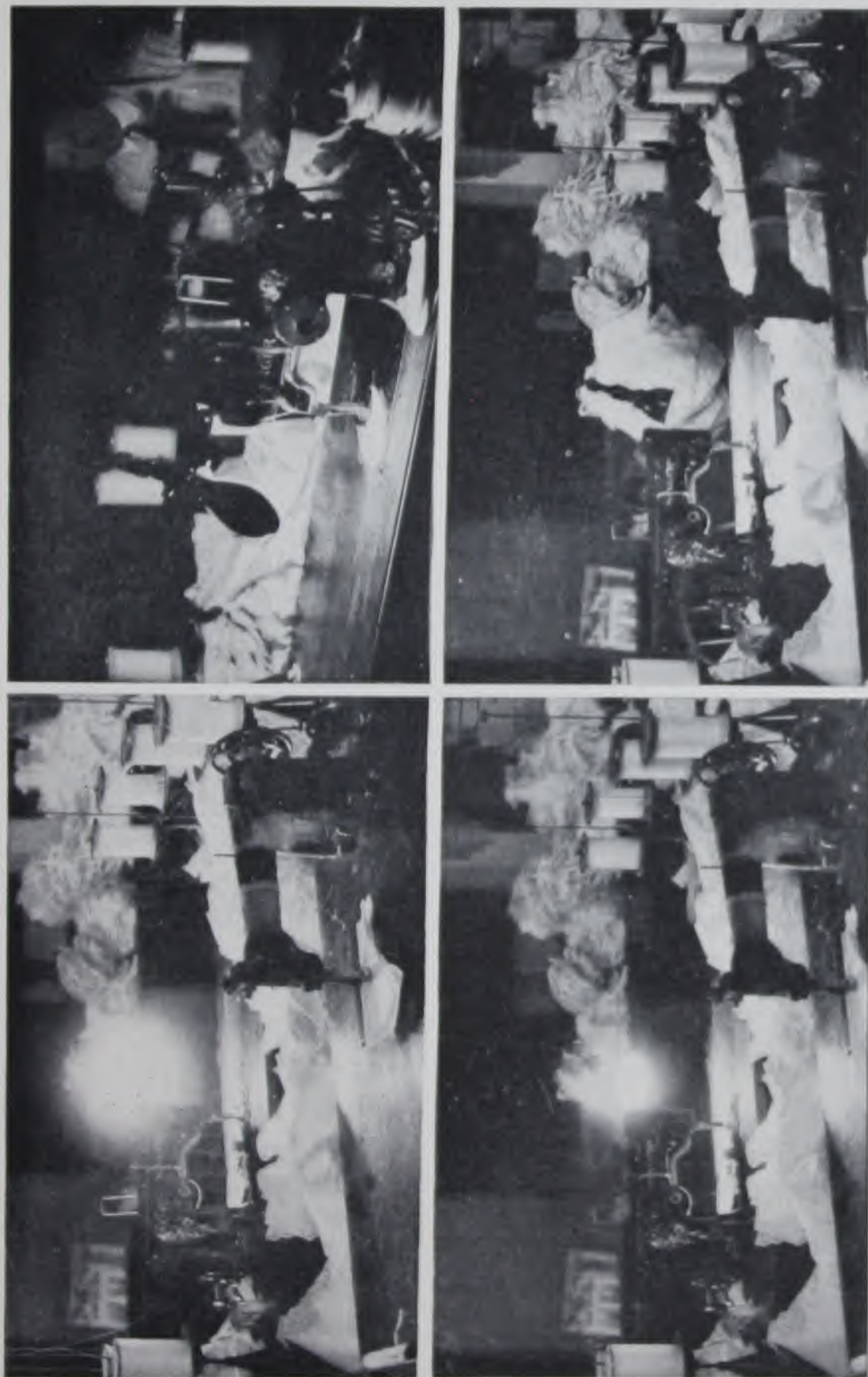


Fig. 4

Conditions to be Avoided in Local Lighting of Sewing Machines. A and B, half-hand shade with clear lamp showing glare in eye of opposite operator. C, a 90-deg. angle reflector almost as bad from the standpoint of glare. D, a small deep bowl reflector, which directs the light on the needle point and shields the eyes of the operator

what lower intensity would be supplied throughout the remainder of the room by a system of general illumination. A typical layout which will give satisfaction under these circumstances is shown in Fig. 3. Care should be taken in choosing the type of reflector for local lighting, as indicated in Fig. 4. A night view of an excellent example of this form of lighting is given in Fig. 5. Intensities of illumination desirable for the various classes of work under this heading will be found in the accompanying tables.

Hand Sewing

In every clothing factory there is a certain amount of hand sewing to be done. This in general is very fine work and requires good illumination. The natural posture for the operator to assume is, while seated, to take the work on her knee. Hence, it is extremely important that the lighting system be installed so as to eliminate the possibility of objectionable shadows being cast upon the work. It is also obvious that the predominating light should come from slightly in front of the position of the operator and preferably from the left. These factors no doubt had a considerable bearing on the fact that today a large number of factories are utilizing local lighting, i. e., one unit per operator, for hand sewing.

To obtain the reduction of shadows, many factories are equipped with opal glass enclosing globes. These fixtures no doubt satisfactorily solve the problem with regard to diffusion; however, the characteristic distribution is such that economical illumination on sewing tables is not produced. Satisfactory results can be obtained by the use of localized general illumination over the sewing table, units hung from 5 to 6 feet above the surface of the table and spaced in the neighborhood of 8 feet apart; 100-watt, 150- or 200-watt bowl enameled MAZDA C lamps in RLM Standard Dome reflectors, the size of unit, of course, depending upon the class of work. There will be good diffusion, objectionable shadows will be reduced to a satisfactory minimum, and the operators will not be handicapped by having a local light constantly in their way.

Cutting

The problem in the cutting room is not so complicated as that in the sewing room. The tables are arranged in parallel rows, two tables back to back, thus giving a combined breadth of

approximately 6 feet, while the distance between rows varies according to the dimensions of the floor area available. It will average, however, approximately $4\frac{1}{2}$ feet. In many factories, the nature of the work done on the cutting tables does not vary greatly. Many are used for machine cutting only, while others are used for hand cutting. In either case the cutter must carefully follow the pattern lines on the goods,



Fig. 5

Night View of Machine Sewing with a Combination of General and Local Lighting. 100-watt frosted MAZDA C lamps in RLM Standard Dome reflectors on 16-foot centers 10 feet above the floor are used for general illumination. 25-watt MAZDA B lamps in deep bowl aluminum finished reflectors provide an intensity of 30 foot-candles at the needle point. The general method of support indicated in Fig. 3 is employed.

and it is obvious that his ability to see easily, quickly and with confidence is of paramount importance, both from the point of view of spoilage and that of output.

Cutting machines are often equipped with an individual low wattage lamp and reflector located in front of the knife. This provides effective supplementary illumination if properly maintained. However, many instances have been noted where lamp and reflector have been removed entirely and in some cases a clear bare 25- or 40-watt MAZDA lamp has been inserted in the socket, defeating the purpose for which the light was originally intended.

The cutter must work the entire length of the table in the majority of cases; hence it is necessary that a fairly even intensity of illumination be produced over the entire table surface. This is not only true for cutting, but also for the placing of patterns and marking of the goods. An arrangement of lighting units similar to that described for the hand sewing table will supply adequate illumination for this type of work, i.e., localized general illumination, whereby the maximum of intensity is supplied on the



Fig. 6

Night View of Localized General Illumination of Cutting Boards. 100-watt MAZDA C lamps in RLM Standard Dome reflectors are spaced on $8\frac{1}{2}$ -foot centers 4 feet above the tops of the tables. The average illumination is over 8 foot-candles

cutting table itself with units being hung at a sufficient height to permit the aisles and less important areas being lighted to a satisfactory intensity. As is the case with the hand sewing tables, the size of the lamps selected will depend largely upon the fineness of goods. Well lighted cutting tables are shown in Fig. 6.

Knitting

The type of machine, arrangement, method of drive and character and color of material must all be given due consideration in designing a lighting system for the manufacture of knit goods. If there is a fairly regular arrangement of machines and few overhanging parts, a system of general illumination will meet the

requirements (see Fig. 7), otherwise localized general illumination will undoubtedly be more practicable.

In most all cases, diffuse illumination is desirable, not only to eliminate direct and reflected glare, but also to produce effective illumination on vertical surfaces and recesses between intricate parts of machines. There is no definite plane which demands the maximum illumination, and for this reason indirect systems or the use of diffusing enclosing globes produce the most satisfactory



Fig. 7

Looping and Seaming of Stockings Can be Carried on Very Effectively Under Lighting Conditions Such as Shown in This Night Photograph. 200-watt bowl enameled MAZDA C lamps in RLM Standard Dome reflectors are hung 10 feet above the floor on centers 7 by 8 feet. High level illumination of 22 foot-candles is the result

results. This may be accomplished by the use of a lighting unit which diffuses the light and gives a fairly wide spread, hung quite high as compared with their spacing and preferably locating outlets between machines rather than directly above.

For large knitting machines, where the parts extend quite high, the lighting must be arranged, not only to illuminate these parts to a satisfactory degree to permit inspection of the operation, but also to eliminate undue glare where the operator looks upward toward these parts. (See Fig. 8.)

Inspection and Folding

Inspection is, perhaps, the operation which makes the most exacting demands with regard to illumination. Inspectors not only examine the work but detect stains, errors in colors, faults in the goods, etc. They are called upon to do this with reasonable speed and great accuracy. Hence, it will be seen that a light which will bring out all of these defects in as pronounced a manner as is possible, should be employed. In many factories as much of the in-



Fig. 8

The Overhanging Parts of Underwear Knitting Machines Cast Dense Shadows Unless Very Diffuse Illumination is Provided. It is necessary to have good illumination on vertical surfaces near to the ceiling as the operator must glance directly upward when threading a broken strand through the eyes. The installation of metal and glass semi-indirect units pictured, meets these conditions in a thoroughly satisfactory manner

spection as is possible is done entirely by daylight, inasmuch as it is found that the color quality of daylight is a distinct asset in matching and detecting imperfections.

It is obvious that satisfactory artificial illumination for this class of work should simulate daylight in color value. Where extreme accuracy of color matching is important, it is obvious that the most accurate type of color matching unit should be used. However, in a large number of cases it is found that the daylight MAZDA lamp by supplying a quality of illumination which permits discrimination of color and discernment of imperfections in cloth will meet the requirements.

The method of installing these units, of course, varies considerably with the class of work and the methods of the management. That is, in underwear factories, for instance, some managers believe that it is efficiency for the inspectors to fold the garment as it is inspected, others believe strongly in the advisability of an inspection department as separate from the folding department, while others believe in combining both departments, that is, placing inspectors and folders side by side—two folders to each in-



Fig. 9

Another Example of High Level Illumination is Seen in This Inspecting Department of a Stocking Factory. 200-watt bowl enameled MAZDA C lamps on an average spacing of 7 feet, provides over 20 foot-candles of uniformly distributed illumination

spector. Hence, it will be seen that for the first two methods mentioned, a system of general illumination would be preferable and that it would be desirable to have this illumination of a daylight color value. In the third case, however, the tables can be arranged so as to make it possible to supply the inspectors with a local color matching unit, whereas the folders can be supplied with illumination from the ordinary incandescent lamp.

Fitting

The requirements in the fitting room are simple and do not vary to any great extent. A medium intensity of general illumination supplied by units which properly diffuse the light will prove satisfactory in the majority of cases.

When the fitting is done on models, no thought need be given to the decorative features of the fixtures. However, the illumination should be such as to eliminate objectionable shadows on the



Fig. 10

Night View of Pressing Department Illuminated by the Combination of General and Localized General Systems. For the former 100-watt bowl frosted MAZDA C lamps in RLM Standard Dome reflectors are placed 10 feet above the floor, at the center of each 16-foot bay. For the latter, 75-watt MAZDA C lamps in similar equipment are on centers 8 by 10 feet, 5 feet above the tops of the tables

model, and if possible the light should approximate the color value of that under which the garment is to be worn.

In cases where the fitting is done on a customer, or rather where a room is designed for that purpose, careful attention should be given to the decorative features of the fixtures. Such a condition approximates those found in a store and should be treated accordingly.

Pressing

Pressing is divided into two classes, i.e., hand pressing and machine pressing. In the former, broad tables are employed, operators standing on each side. Each operator has a buck which

stands about 9 inches from the table and is about 2 feet long. On this most of the pressing is done. While the work is not of a particularly fine nature, a fairly high intensity of illumination is required. Since the operators face the table, a localized general system of illumination, consisting of a row of lights hung over the center of the table, 5 to 6 feet above the table top (as shown in Fig. 10), or a well designed system of straight general illumination will meet the requirements. In order that scorches may be more easily detected, it is recommended that the installation of daylight MAZDA C lamps be considered for this process. With illumination of a color value approximating daylight, the brown or yellow caused by the scorch will be more easily detected than if a light having a preponderance of yellow rays is used.

When ironing machines are used, it will often be found desirable to utilize a system of localized general illumination, on account of the liability of shadows being cast by overhanging parts. For this service the units should be hung almost directly above the head of the operator. An equipment which will meet the lighting requirements consists of the RLM Standard Dome reflector and a 75-watt bowl frosted MAZDA C lamp hung about 9 feet from the floor.

Laundering

In the laundry the construction of much of the machinery is such that objectionable shadows may be encountered, unless the lighting equipment is carefully selected and installed. With the many overhanging parts, the location of outlets is especially important. Localized general illumination is recommended for the majority of operations where average conditions exist.

As mentioned under headings of pressing and inspecting, daylight MAZDA lamps are quite applicable for similar operations in the laundry as an aid in the detection of spots, stains and scorches.

Stockroom

The layout for this room generally consists of rows of shelves or racks on which the finished goods are placed before being shipped. Since it is necessary to read the labels which are usually in small print or writing on the tag, a reasonably good intensity of illumination is required. A satisfactory method of illumination consists of locating rows of units down the center of the aisle between the racks; a reflector giving a fairly wide spread being usually desirable. Lighting units should be hung at a height so that they will

come at least to the top of the shelves and preferably slightly higher. 75-watt bowl frosted MAZDA C lamps in RLM Standard Dome reflectors or shallow dome reflectors, spaced from 10 to 15 foot centers, will supply fairly adequate illumination.

Sample and Show Room

Here the problem very closely resembles that in the modern store. A fairly high intensity of well diffused general illumination will meet the requirements. Care should be exercised in the selection of fixtures in order that the proper decorative element will be obtained. The employment of either semi-indirect or totally indirect lighting fixtures would be justified in this case.

Under some conditions the use of the daylight MAZDA lamp will prove advantageous, this being true, of course, if the goods on display are of such a nature that it is desired to bring out the colors in the true form, or where it is desirable to discriminate between different colors. Under the most exacting conditions of color discrimination, it is recommended that the more accurate form of color matching units be employed.

Packing and Shipping

The requirements for this class of work present no great difficulty. A system of general illumination with a reasonable intensity will suffice. Approximately 1 watt per sq. ft. will supply adequate illumination. The type of reflector which meets the demand in the majority of cases is the RLM Standard Dome. Lighting units should be installed so there will be no great variation in intensity and a reasonable minimum of objectionable shadows.

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TABLE I

Operation	COATS AND SUITS (Dark)		COATS AND SUITS (Light)		CORSETS		UNDERWEAR		SHIRTS, COLLARS AND WAISTS		KNIT GOODS EXCLUSIVE OF UNDERWEAR		FURS		OVERALLS		GLOVES	
	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.	System	Intens. in Ft. Cdls.
Designing	L&G	L. 30-40 G. 12-15	L & G	L. 25-30 G. 8-10	L & G	L. 25-30 G. 8-10	..	..	L & G	L. 15-20 G. 2-4	G	6-8	L & G	L. 30-50 G. 12-18	..	..	..	..
Machine Cutting	LG	8-10	LG	6	LG	6	LG	6-8	LG	5-7	..	..	..	..	LG	4-6	LG	5-7
Hand Cutting	LG	10-12	LG	8-10	LG	8	..	..	LG	6-8	..	..	..	..	LG	4-6	..	8-10
Shading	†LG	15	†LG	15	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Machine Sewing	L & G	L. 30-40 G. 4-6	L & G	L. 25-30 G. 4-6	L & G	L. 25-30 G. 4-6	LG	10-12	LG	8-10	LG	8-10	L & G	L. 30-50 G. 6-8	LG	6-8	L & G	L. 25-30 G. 4-6
Hand Sewing	LG	15-20	LG	12-15	LG	10-12	LG	10-12	LG	8-10	LG	8-10	LG	15-20	..	..	LG	15-20
Other Hand Work	G	6-8	G	4-6	G	4-6	G	3-4	G	4-6	G	4-5	..	..	..	..	LG	5-8
Pressing-Ironing	†LG	8-10	†LG	8	..	..	..	..	LG	4-6	..	..	..	..	..	..	..	..
Examining	Color matching units	15-20	Color matching units	12-15	†LG	10-12	†LG	10-12	†LG	10-12	†LG	8-10	Color matching unit	15-20	LG	6-8	Color matching units	15-20
Folding	..	..	..	..	..	..	G	4-6	G	4-6	G	4-5	..	..	LG	6-8	..	..
Knitting	..	..	..	..	..	..	LG	6-8	..	..	LG	10-12	..	..	..	..	..	10-12
Laundry	..	..	..	..	..	..	LG	2-4	LG	4-6	LG	5-10	..	..	..	..	..	..
Fitting Room	G	8-12	G	8-12	..	..	..	..	..	..	..	..	G	8-12	..	..	..	..
Sample and Show Room*	G	10-12	G	8-10	G	8-10	G	8-10	G	8-10	G	8-10	G	10-12	G	8-10	G	8-10
Stock and Shipp'g	G	2-6	G	2-6	G	2-6	G	2-6	G	2-6	G	2-6	G	2-6	G	2-6	G	2-6

Symbols { G—System of general illumination.

LG—Localized general system of illumination.

L & G—Local and general systems combined.

*Color-matching units where accurate color discrimination is necessary.

†Daylight Mazda Lamps—bowl enameled or bowl frosted.

TABLE II

Operation	HATS	
	System	Intensity in Ft. Cdl.
Machine Sewing	L & G	L. 15-20 G. 4-6
Hand Sewing	LG	8-10
Pressing and Ironing	LG	5-10
Examining	LG	10
Braiding	LG	6-8
Fur Room	LG	6-8
Blowing	LG	4-6
Forming and Hardening	LG	6-8
Sizing	G	5-6
Stiffening	G	5-6
Stretching and Blocking	G	5-6
Finishing	LG	8-10
Sample and Show Room	G	10-12
Stock and Shipping	G	2-6

Symbols { G—System of general illumination.
 LG—Localized general system.
 L & G—Local and general systems combined.

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